1945: The Exclusion Principle

History:

In the 1920's, while trying the explain the recent empirical discoveries about the structure of electrons around the nucleus of an atom, Pauli came to realize that the structure could be explained if an electron in an atom wasn't allowed to be in the same quantum state as another electron in that atom. To prove this he had to introduce the fourth quantum number of an atomic orbital, spin quantum number.

Over the next few decades this was generalized by Pauli and others to include all particles with a half-integer spin, called fermions.

Importance:

There are many reasons why the Exclusion Principle is important. Since it keeps all the electrons in an from dropping into the lowest energy state it makes the electrons stay in higher energy, larger shells, essentially giving atoms volume, it's one of the things, along with the electrostatic force, that says that macroscopic objects can't occupy the same space, and it supplies the force opposing gravity in neutron stars and white dwarf stars that keeps them from collapsing among numerous other effects.

The Exclusion Principle underlies essentially every interaction between fermions and as such is one of the fundamental pillars of modern physics.